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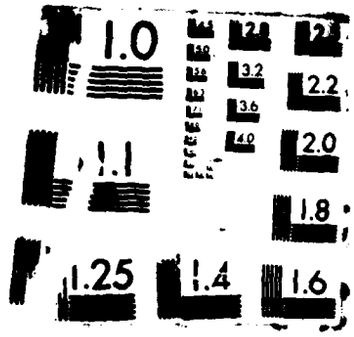
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WES-TNO CONTAMINANT MOBILITY RESEARCH FINAL TECHNICAL REPORT

J.M. Marquenie

TNO

(2)

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J.M. Marquenie

1. INTRODUCTION

The following is a summary report in reference to contract DAJA45-85-C-0027, including its later modification. This report is a presentation of the information requested by the contract and is in a format previously agreed upon by the contracting parties, WES and TNO.

2. STATEMENT OF WORK

2.1 WORKSHOP IN BUFFALO, 1984 (ENCLOSURE 1)

Full travel and per diem were arranged for ten European scientists to evaluate research programmes in relation to contaminant mobility from dredged materials into ecosystems. As negotiated, one more European, dr L. Tent was only reimbursed for travel. The workshop was held in Buffalo (N.Y.) from 13-17 May 1985.
A list of the names of the European scientists that were invited through contract DAJA45-85-C-0027 is included in enclosure 1.

Among the invited Europeans M.S. Johnson and H. Nijssen were not able to attend the workshop, and dr G. Bryan was, in consultation with the WES, replaced by dr B. Langston.
A select group of experts was invited to arrive early or to depart late in order to reach the optimum benefit of their stay by having the opportunity for more detailed discussions.
At our request dr B.A. Hunter arrived on May 11, to previsit the site. Also at our request dr C.A. Edwards departed on May 18, while W.H.O. Ernst and W.C. Ma departed on May 20.
Dr E. Stafford, also from Europe, does not appear on the list because special arrangements were made between her and the WES directly.

Accomplishments:

Intensive investigations and inventories were conducted at the Times Beach confined disposal site, which aided in the development of research objectives and future management concerns. (cont'd pg 4)
Along with these investigations an outline was constructed which related to future research at Times Beach and to how investigations in this area could be compared with those being conducted not only in the United States, but also in Canada and Europe. These efforts were constructed with reference to socio-economic impacts of these sites.

Task groups, comprised of experts, were also organized. These groups prepared specific reports. These reports were subsequently reviewed by peers and ammended by the entire team of experts and then incorporated as research strategies.

Editing and wordprocessing of these reports into final proceedings was not part of the TNO proposal, but was done at the WES in Vicksburg. These proceedings of this 1984 workshop are included as enclosure 1.

The workshop received very positive comments not only from its distinguished participants, but also from the news media. Local newspapers and television news networks covered much of the proceedings and added positively to the public image of the Corps of Engineers.

The team of international experts also reviewed and discussed updates and reports of research 1983 and 1984, and were beneficial in interpreting data, and correlating them with present and future research efforts.

2.2 SPECIAL TASKS AT REQUEST OF U.S.P.O.C.

2.2.1 Scientific officer

One scientific officer, Joop M. Marquenie, was stationed at tthe WES in Vicksburg (MS) for 78 days (April 28 until July 10, 1985) to provide expert input and support to ongoing research projects. He was there at full disposal of the WES and collaborated intensively with his colleague of the WES, John W. Simmers and various USACE District Offices. He was also intensively engaged in several research projects. These projects are briefly identified by the following code names:

- Benton Harbor
- Times Beach
- Bridgeport
- Morton Arboretum
- Indiana Harbor.

BENTON HARBOR

Three Benton Harbor (ID) field sites were visited from 28 April until 1 May. The sites were inspected, transects were lined out and sampling stations were selected. From each sampling station replicate soil or sediment samples were collected that were transported to the WES. At the WES an earthworm bioassay was run with these materials. At the time Joop M. Marquenie return-

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ed to the Netherlands tissues and soil samples were ready for analysis and most basis assessments were done.
From June 26 to June 27 a meeting was attended at the District Office in Detroit together with the Fish and Wildlife Service in order to discuss and evaluate the prelimenary data. The final report on Benton Harbor bioassays is, of course, a full WES responsibility to their sponsor and will therefore not be included in this report.

TIMES BEACH (Enclosures 2, 3 and 4)

Times Beach (N.Y.) was visited from May 10 until May 24 and from June 30 until July 3.
In addition to the work described under "workshops", new transects were established at the site. In co-operation with District personnel soil and sediments samples were collected from designated stations within identified ecological habitats.

Earthworm bioassays

Soil and sediments samples for an earthworm bioassay were collected from different depths representing the significant horizons that had developed ~~been~~ over time. Also, at each station, sampls of native earthworms were collected for analysis and the species were identified.
At the time the principal TNO investigator returned to the Netherlands all necessary preparations had been made to run the bioassay at the WES laboratories in Vicksburg, including stocking the containers with earthworms. Further handling of the bioassay was left under full control and responsibility of the WES experienced personnel. Finally, a first draft was made of official guidelines for the earthworm bioassay.
No further statements can be made, of course, until the results of this bioassay have become available.

Musselwatching (Enclosure 2)

A sampling station to collect background mussels for mussel watching at Times Beach was identified. Mussels were collected and ~~according to TNO procedures,~~ exposed in Times Beach and Lake Erie. Mussels were also exposed at key locations in the Buffalo River in order to give an early warning to the District of future contaminant related dredging problems in the Buffalo

River. The mussels were recollected on the second trip, preserved by freezing and together with the native earthworm samples transported to TNO in the Netherlands by Joop M. Marquenie. At the TNO laboratories the mussels were dissected and prepared for analysis on specific PCB congeners and pesticides (op-DDE, pp-DDE and HCB).
The results were evaluated against future Corps of Engineers dredging operations in the Buffalo River. This indicated where concentrations can be assumed to build up in the sediments in relation to discharges in the river. The results were also evaluated against the potential impact of Times Beach on Lake Erie water quality, while it was indicated that there was no transport of bioavailable PCBs from Times Beach. Furthermore, indications were found for a PCB gradient in Lake Erie, pointing to the potential existence of sources more southern from Times Beach.
Finally it was stated that although PCB concentrations in mussels exposed at Times Beach were high, the concentrations of higher chlorinated congeners (i.e. those that are related to effects food chains), were low.
Enclosure 2 contains the detailed report.

Duck studies

High numbers of several waterfowl species have been found breeding in the Times Beach wetland. In order to assess uptake of contaminants that in the disposal site are present in the waterfowl, young ducks were shot prior to fledging. The bodies were transported to TNO laboratories and subjected to a full histopathological inspection, including light-microscopic examination of the tissues.
Livers of the ducks were analysed for metals. PCBs and PAHs and the raw data were directly reported to the WES. Because the data would gain tremendously in value if brought in relation to Times Beach musselwatching and longterm feeding studies with ducks and mussels at TNO it was decided to integrate the data into a WES-TNO publication. A joint manuscript is presently in preparation and will be submitted to an international journal in January 1987.
It is recommended to concentrate further studies at disposal sites on bird eggs, because these eggs appear precisely to reflect contamination in the surrounding of the nest. Essential parameters to assess are:

- clutch size, size and weight of the eggs.
- development of the embryos.

- concentrations of PCB congeners 153, 138 and 180, HCB, DDE. Depending on the site, concentrations of mercury and selenium, too, may be of interest.

Aquatic and benthic inventories (Enclosure 3)

Following the recommendation of The workshop expert task group that evaluated the aquatic habitat at Times Beach recommended aquatic and benthic inventories. These were subsequently conducted. Invertebrates were collected by sieving sediments from Times Beach and plankton was collected from Times Beach and the adjacent part of Lake Erie. The samples were preserved and transported to TNO for inspection. Enclosure 3 contains a short communication, revealing that at the time of sampling the plankton at Times Beach is much richer in species and higher in biomassa than that of Lake Erie.
In addition to the report it is mentioned that the chironomid larvae that were inspected by a Dutch expert on malformations in this species (G. van Urk, RWS-RIZA), indeed showed a more compacted growth form than what would seem normal. More specimens from inside Times Beach and reference specimens from outside are needed in order to ascertain these observations.

Native fish were collected from Times Beach by carrying out electroshocking in 6 transects. Together with the results from netting in 1983, a full species assessment is now available. Moreover, data from 1985 allow a density and biomass assessment according to species. These latter observations can form the basis for production assessments at the site if sampling is continued by the WES.

BRIDGEPORT (Enclosure 4)

The Bridgeport site (CT) was visited from June 23 until June 26. The upland disposal section was carefully examined. It proved that this section was still highly incompatible with plant and animal life, probably due to high sediment compaction and extreme salt concentrations of the sediment surface. In contrast, at a depth of about 0.60 meter the material still appeared to be reduced and loosely consolidated. In order to improve the leaching of salts and to facilitate seed germination twe sectors of 75 square meters were each rotor-tilled. Within these sectors 8 experimental earthworm testing units were installed and stocked with earthworms.

In the wetland section at Bridgeport a 1x1 meter grid system was overlaid and the density of naturally colonizing *Nereis succinea* was assessed.
In co-operation with the EPA laboratory Narragensett Bay background populations of *Nassarius obsoletus*, *Mytilus edulis* and *Modiolus demissus* were identified. Sufficient numbers of these three species were collected from this area and were later exosed to the experimental wetland section at Bridgeport.

Several samples in relation to this Field Verification Project were analysed and reported within a former contract. They included a selection of samples from a tidal bioassay, run on sediments to be deposited before completion of the site.
Within this contract several samples were analysed from a bioassay with sediments after completion of the site (those mentioned under 2.2.2).
The results of the above two sets of experiments were integrated and evaluated into a memorandum for record (Enclosure 4).
It was concluded that at that time statistical comparison of the data was not possible. The reason was that the number of samples that could be analysed was limited, although results of both experiments fell within the same range. Moreover, only after the data had been evaluated *Nereis succinea* was found to have invaded the site and samples were collected.

On account of the present knowledge, the following can be recommended:

- Analyse all *N. succinea* samples collected at the site in 1985.
- Analyse all Nereis samples from the 1983 tidal bioassay that had not been analysed before. This is the bioassay that had been fully accomplished before the FVP site was constructed.
- Make a weighed estimate of uptake rates per component, combining at least two treatments (BR and BR-ref).
- This will then yield an estimate of variance-covariance based on the minimum of 2x6 (2 treatments x 6 points in time) variables, from which both confidence limits can be assessed for levels reached after 28 days of exposure, and in an equilibrium situation.
- Concentrations can be calculated after 28 days of exposure. Because of the estimated variance, these concentrations can then statistically be compared with those assessed in the 1984 bioassay.

Subsequently, certain concentrations, together with their confidence limits, can statistically be compared with those in Nereis that actually invaded. The former concentrations comprise those forming the predicted levels that would be reached in case Nereis should invade the site.

As a result it will be possible to state to what degree, a bioassay predicts, prior to dumping, concentrations of contaminants in organisms that have actually invaded dumping sites. The concentrations of contaminants in the bioassay from the dumping site after dumping show the real degree of contaminants. A relation between the two can thus been established.

MORTON ARBORETUM (Enclosure 5)

A selection of soils and earthworm tissues was analysed for metals and PAHs. The samples were obtained from a bioassay with soils collected from the Morton Arboretum at different depths along a transect running from a main highway as far as the centre of the arboretum.
Increased concentrations of metals and PAHs were found in the surface layers close to the highway. This resulted in increased levels in the exposed earthworms. Surprisingly, the contamination with cadmium proved to be severe and extremely bioavailable. Data were evaluated in a joint Morton Arboretum-WES-TNO publication (enclosure 5).
Further studies on the effects of the above-mentioned accumulations on litter decomposition are highly recommended.

INDIANA HARBOR

In discussion with the US point of contact it was decided to analyse the samples of the musselwatch at Times Beach.

2.2.2 Laboratory assistant

TNO laboratory assistance was needed for invertebrate identification and for dissection and preparation of samples that were transported to TNO in 1984 and in 1985.
In subsamples the percentages of water and organic tissue were determined.

2.2.3 Manuscript review

Four different manuscripts were reviewed for the WES.

2.3 CHEMICAL ANALYSIS

Results of chemical analyses are given in the enclosed reports.

Report: R 87/15 WES-TNO Contaminant Mobility Research
Final Technical Report

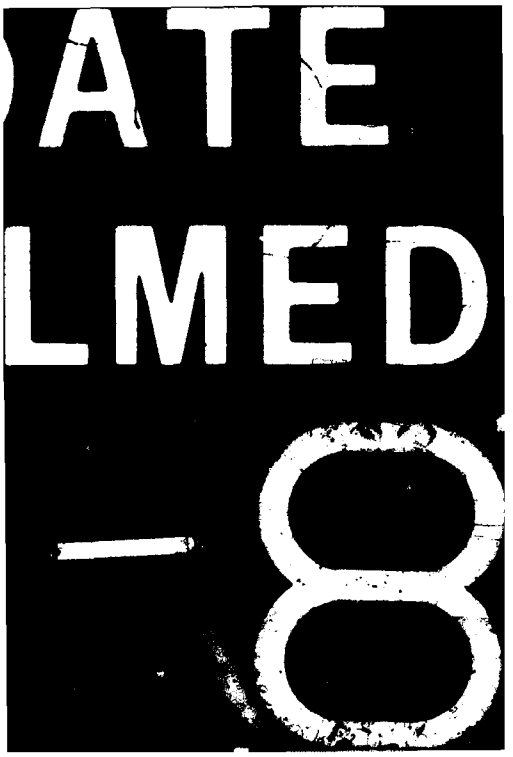
Appendices 1: R 87/023 Proceedings of the 1984 Workshop, held at Buffalo, USA

2: R 86/199 Musselwatching in the Buffalo River, Times Beach and Lake Erie

3: R 86/220 Preliminary inventory of planktonic and benthic organisms at Times Beach

4: P 85/50 Animal bioassays of black rock harbor sediments - Field verification at an experimental wetland-creation disposal site

5: P 87/007 Morton Arboretum Bioassays.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